

## CLAIMS

1. A method for amplifying an optical signal having frequency in a signal frequency range, comprising
  - 5       – introducing said optical signal respectively into at least a first (11) and a second optical paths (12) disposed in series with each other, each comprising a Raman-active material having a predetermined Raman shift;
  - introducing into said first optical path (11) a first pump portion, said first  
10       pump portion including a first group of pump frequencies between a first minimum pump frequency and a first maximum pump frequency;
  - introducing into said second optical path (12) a second pump portion, said second pump portion including a second group of pump frequencies between a second minimum pump frequency and a second maximum  
15       pump frequency, a whole of said first and second group of frequencies extending over a pump frequency range having a width of at least the 40% of said Raman shift;characterized in that
  - 20       – at least a portion of said first group of frequencies is not included in said second group of frequencies and at least a portion of said second group of frequencies is not included in said first group of frequencies;
  - said steps of introducing said first and second pump portions into said first and second optical paths are performed such that a residual of said second pump portion entering into said first optical path has a power  
25       lower by 10 dB than said first pump portion, and such that a residual of said first pump portion entering into said second optical path has a power lower by 10 dB than said second pump portion;
  - said first minimum pump frequency and said first maximum pump frequency differ with each other of at most the 70% of said Raman shift;  
30       and
  - said second minimum pump frequency and said second maximum pump frequency differ with each other of at most the 70% of said Raman shift.
2. A method according to claim 1, characterized in that said steps of introducing  
35       said first and second pump portions into said first and second optical paths are

performed such that a residual of said second pump portion entering into said first optical path has a power lower by 13 dB than said first pump portion, and such that a residual of said first pump portion entering into said second optical path has a power lower by 13 dB than said second pump portion.

5

3. A method according to claim 1 or 2, characterized in that said first minimum pump frequency and said first maximum pump frequency differ with each other of at most the 50% of said Raman shift, and said second minimum pump frequency and said second maximum pump frequency differ with each other of at most the 50% of said Raman shift.
4. A method according to any one of claims 1 to 3, characterized in that said pump frequency range has a width of at least the 50% of said Raman shift.
5. A method according to any one of claims 1 to 4, characterized in that said first and second group of frequencies do not overlap with each other.
6. A method according to any one of claims 1 to 5, said first minimum and said first maximum pump frequencies defining a first pump frequency range and said second minimum and said second maximum pump frequencies defining a second pump frequency range, characterized in that at least one of said first and second pump frequency ranges has a width of at least the 20% of said Raman shift.
7. A method according to any one of claims 1 to 6, characterized in that said first group of frequencies is adapted for Raman amplifying a first portion of said optical signal, said second group of frequencies is adapted for Raman amplifying a second portion of said optical signal, the first portion of optical signal having a greater attenuation versus wavelength in said Raman-active material than said second portion of optical signal.
8. A method according to any one of claims 1 to 7, characterized in that it further comprises a step of providing said first and said second pump portions by a plurality of pump lasers, said plurality of pump lasers having an overall

variation of pump power emission of at most the 50% of an average pump power emission.

5 9. A Raman amplifier (10) adapted for amplifying an optical signal having frequency in a signal frequency range comprising at least a first (11, 21) and a second (12, 22) optical paths disposed in series with each other, each comprising a Raman-active material having a predetermined Raman shift, said amplifier (10) comprising:

- 10 – a first pump source (13) connected to said first optical path (11, 21), said first pump source (13) being adapted for emitting and coupling into said first optical path (11, 21) a first pump radiation including a first group of pump frequencies between a first minimum pump frequency and a first maximum pump frequency;
- 15 – a second pump source (14) connected to said second optical path (12, 22), said second pump source (14) being adapted for emitting and coupling into said second optical path (12, 22) a second pump radiation including a second group of pump frequencies between a second minimum pump frequency and a second maximum pump frequency, a whole of said first and second group of frequencies extending over a pump frequency range having a width of at least the 40% of said Raman shift;

characterized in that

- 25 – at least a portion of said first group of frequencies is not included in said second group of frequencies and at least a portion of said second group of frequencies is not included in said first group of frequencies;
- the couplings between said first and second pump sources and said first and second optical paths are such that a residual of said second pump radiation coupled into said first optical path has a power lower by 10 dB than said first pump radiation, and such that a residual of said first pump radiation coupled into said second optical path has a power lower by 10 dB than said second pump radiation; and
- 30 – said first minimum pump frequency and said first maximum pump frequency differ with each other of at most the 70% of said Raman shift; and

- said second minimum pump frequency and said second maximum pump frequency differ with each other of at most the 70% of said Raman shift.

- 5 10. A Raman amplifier (10) according to claim 9, characterized in that the couplings between said first and second pump sources and said first and second optical paths are such that a residual of said second pump radiation coupled into said first optical path has a power lower by 13 dB than said first pump radiation, and such that a residual of said first pump radiation coupled into said second optical path has a power lower by 13 dB than said second pump radiation.
- 10 11. A Raman amplifier (10) according to any one of claims 9 or 10, characterized in that said first minimum pump frequency and said first maximum pump frequency differ with each other of at most the 50% of said Raman shift, and
- 15 said second minimum pump frequency and said second maximum pump frequency differ with each other of at most the 50% of said Raman shift.
12. A Raman amplifier (10) according to any one of claims 9 to 11, characterized in that said pump frequency range has a width of at least the 50% of said
- 20 Raman shift.
13. A Raman amplifier (10) according to any one of claims 9 to 12, characterized in that said first and second group of frequencies do not overlap with each other.
- 25 14. A Raman amplifier (10) according to any one of claims 9 to 13, said first minimum and said first maximum pump frequencies defining a first pump frequency range and said second minimum and said second maximum pump frequencies defining a second pump frequency range, characterized in that at
- 30 least one of said first and second pump frequency ranges has a width of at least the 20% of said Raman shift.
15. A Raman amplifier (10) according to any one of claims 9 to 14, characterized in that said first group of frequencies is adapted for Raman amplifying a first
- 35 portion of said optical signal, said second group of wavelengths is adapted for

Raman amplifying a second portion of said optical signal, the first portion of optical signal having a greater attenuation versus wavelength in said Raman-active material than said second portion of optical signal.

- 5 16. A Raman amplifier (10) according to any one of claims 9 to 15, characterized in that said first and said second pump sources (13, 14) comprise a plurality of pump lasers, said plurality of pump lasers having an overall variation of pump power emission of at most the 50% of an average pump power emission.
- 10 17. An optical system comprising at least one optical line, said optical line including at least one optical fiber and at least one Raman amplifier (10) according to any one of claims 9 to 16, connected to said optical fiber.
- 15 18. An optical system according to claim 17, characterized in that it further comprises a transmitting station including a plurality of transmitters adapted for emitting a respective plurality of optical channels, each having a respective wavelength, said transmitting station being connected to a first end of said optical line.
- 20 19. An optical system according to claim 18, characterized in that it further comprises a receiving station including a plurality of receivers adapted to discriminate an information carried by said optical channels, said receiving station being connected to a second end of said optical line.